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Effect of trained Seizure Alert Dogs® on frequency of tonic–clonic seizures

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We have previously reported that dogs can be trained to recognize specific changes preceding an epileptic seizure in humans. Such dogs can provide an overt signal that acts as a useful warning to the human. Early observations suggested that seizure frequency might also be reduced. We report a prospective study of 10 consecutive referrals to our Seizure Alert Dogs® service of people with tonic–clonic seizures. Seizure frequency was monitored over a 48 week period including 12 weeks baseline after entry, a 12 week training period, and 24 weeks follow up. Comparing baseline seizure frequency to the last 12 weeks of follow up, there was a 43% mean reduction in seizure frequency ($P = 0.002$). Nine out of /10 subjects showed a 34% or greater reduction, 4/10 showed a 50% or greater reduction, and only one showed no improvement. Although a significant drop in seizure frequency was seen during the first 4 weeks of training ($P = 0.0078$) a further drop occurred between the first and last 4 week period of training ($P = 0.038$) and this final improvement was maintained for the whole 24 week follow up.

Key words: epilepsy; seizure alert dogs; seizure frequency.

INTRODUCTION

There are anecdotal reports of dogs spontaneously responding to human seizures. As we have described in a separate report, this may have a serious adverse effect on both human and canine health[1].

Using a carefully designed protocol we have shown that it is possible to train selected dogs alongside humans with seizure disorders so that the dog may be able to give a useful warning of a seizure to the person without causing harm to the dog[2]. In these cases the mechanism is based on canine sensitivity to what are often subtle behavioural changes in humans. Important points include introducing the selected dog to the human and socializing them together under supervision, and then training the dog to recognize and anticipate that person's seizures using a reward-based operant conditioning paradigm. Intermittent positive reinforcement is used to maintain the learning effect. Follow up with the dog trainer is an important part of the approach. No adverse effects on canine or human health or safety seem to result from this carefully designed approach. An unexpected finding from this early work was that the human subjects reported a reduction in seizure rate.

We report a further investigation with a prospective study of seizure frequency outcome in 10 people with epilepsy consecutively referred to the Seizure Alert Dogs® programme. Because of our observations regarding serious adverse consequences of untrained dogs, we do not feel it is appropriate to use a study design with untrained dogs as animal companion controls. Also, it is still early in the development of the technique, and so our preliminary investigations continue for the time being using subjects as their own controls.

SUBJECTS AND METHOD

Subjects were referred to Support Dogs via the British Epilepsy Association and invited to participate in the

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Table 1: Inclusion criteria.

Inclusion criteria	Exclusion criteria
• Males and females aged 16+ years • Confirmed diagnosis of epilepsy with tonic–clonic seizures • Ability to give informed consent • Minimum of four tonic–clonic seizures per month in the 3 month period prior to enrolment • No useful warning prior to seizures • Medication stable for 3 months prior to enrolment • Prepared to have no medication changes throughout study period (use of rescue benzodiazepines is acceptable) • Must live with someone who is able to care for the dog if necessary	• Any history of non-epileptic attack disorder • Warnings experienced prior to seizures • Any medication change within the last 3 months prior to enrolment

study. Informed consent was obtained from all the subjects taking part. All subjects had a diagnosis of epilepsy with tonic–clonic seizures uncomplicated by non-epileptic attack disorder, as confirmed by their referring neurologist. Precise inclusion and exclusion criteria are given in Table 1. There were four male and six female subjects aged 2139 years (mean age 33.8 years, standard deviation 6.1). Five subjects (three female, two male) experienced only tonic–clonic seizures. One 21 year-old female also experienced absence seizures and the remaining two males and two females also experienced complex partial seizures. For the purposes of this study only tonic–clonic seizures were included in the analysis, as these were relatively easy to count and it was felt that such counting would be reliable. Referral was made to the programme because the person did not experience a useful warning of a seizure and wished to acquire a Seizure Alert Dog® for this purpose. Seizure frequency was measured via the use of seizure diaries. Each subject recorded type, duration and time of seizures on a monthly basis. Enrolment into the study was followed by a 12 week baseline period in which no intervention occurred other than collection of seizure frequency data. Each subject then entered a 12 week training period with a prospective seizure alert dog and trainer. The dogs were trained, alongside the human subjects, to provide a useful behavioural warning of the onset of a seizure using the method that we have described elsewhere, which includes intensive video observation at the dog training centre and at the subject's home[2,3]. Seizure frequency data were collected for a further 24 weeks after training.

RESULTS

Monthly tonic–clonic seizure frequency recorded during baseline varied between subjects from 6.3 to 45.6 with a mean of 13.8. This changed during the 12 week training period to a mean of 9.7 (1.7–37) and dropped further to 8.8 (1.7–30) and 8.5 (2–30) during the first and second 12 week periods of follow up, respectively. Details for each subject are given in Table 2, and changes in mean seizure frequency per 4 week period are shown in Fig. 1. At the end of the study overall seizure frequency had reduced by 43%, with 9/10 subjects showing a reduction of 34% or more. Four out of 10 subjects had experienced a >50% reduction in seizure frequency, and six had experienced >40% reduction. Figure 2 shows the percentage change in seizures for each subject during study. Only one subject showed no improvement. Mean seizure frequency at baseline was compared with that during training, during the first and second 12 week periods of follow up and with the whole follow up period. There was a significant overall reduction in seizure frequency during the training period ($P = 0.0039$, 2-tailed), which was maintained during the 24 weeks of follow up ($P = 0.002$), and this is shown in Table 3.

B1–B3 = Baseline; T4–T6 = Training; F7–F12 = Follow-up

Fig. 1: Change in mean seizure frequency.

There were no significant findings comparing seizure rates during the first and last 4 weeks of baseline, but there did appear to be a significant effect during the first 4 weeks of training compared to the last 4 weeks of baseline ($P = 0.0078$, median difference = 2.5, 95% CI = 1–4). Also, seizure frequency reduced during the period of training (weeks 13–16 of study vs. weeks 21–24, $P = 0.038$ median difference 1.5, 95%

Table 2: Seizure counts in 4-week periods.

	Baseline			Training			Follow-up					
Four-week periods	1	2	3	4	5	6	7	8	9	10	11	12
Subject 1	7	10	8	6	6	5	7	5	5	5	6	5
2	5	7	7	4	2	2	3	4	1	3	4	2
3	6	8	6	6	3	3	4	5	4	4	5	4
4	47	41	49	43	41	27	27	31	32	29	31	30
5	15	16	14	14	15	16	16	15	14	15	14	15
6	5	11	9	4	3	3	3	1	3	2	3	3
7	5	9	5	4	5	3	3	3	3	2	3	2
8	10	15	11	8	9	7	8	10	9	7	7	8
9	4	4	5	2	2	1	1	2	2	3	1	2
10	28	28	19	17	17	14	17	7	19	16	15	9

Table 3: Mean number of seizures in each 4-week period.

	Baseline weeks 1–12	Training weeks 13–24	Follow up weeks 25–36	Follow up weeks 37–48	Total follow up weeks 13–48
Mean no. seizures in each 4-week period	13.8	9.73	8.8	8.0	8.65
P (2 sided) compared to baseline		0.0039	0.0039	0.002	0.002
Median difference		3.67	3.50	4.00	3.75
95% CI[a]		2.5–6.17	2.5–9.17	2.33–9.0	2.42–9.08

[a] Wilcoxon signed ranks.

CI 0.5–8.5) and this improvement was maintained during 24 weeks of follow up.

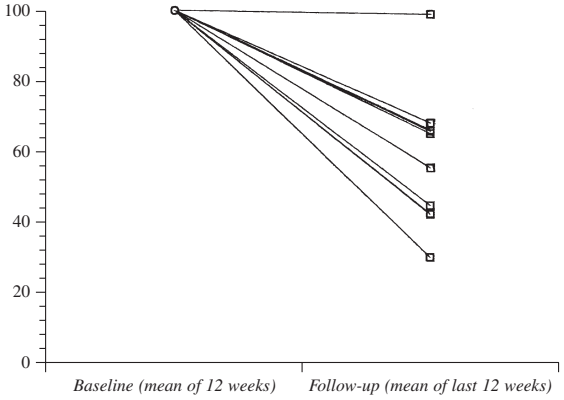

Fig. 2: % change in seizure frequency per subject.

DISCUSSION AND CONCLUSION

This pilot study is based on a relatively small number of subjects. Nevertheless it suggests that properly trained Seizure Alert Dogs® may play a part not only in providing a warning of impending tonic–clonic seizures in humans who would otherwise not have a useful warning, but that using dogs in this way may play a part in reduction of seizure frequency. This supports the anecdotal observation reported by us earlier[2,3]. None of our subjects actually became seizure-free, and one was not helped at all, but the majority experienced an improvement.

Perhaps this observation should not come as a surprise. There has been much interest in the relationship between well-being in epilepsy and its relationship to locus of control and perceived self-efficacy[4–7]. Some of our subjects have told us that gaining the ability to predict their seizures has allowed them to engage in more activities than before, and has reduced some of the fear of the condition. Whether this increased self-confidence alone is sufficient to alter seizure frequency is not clear, but it is possible that increased levels of activity and engagement in tasks has an effect[8].

In order to take this work further we propose to carry out larger scale studies in which we measure health-related quality of life and seizure severity as well as frequency. It is necessary to ensure diagnostic rigour. We will also consider the effect on other seizure types besides tonic–clonic.

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